Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Standard Operating Procedure (SOP) #7: Water Quality Multiprobe Calibration and Field Measurements

Draft Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP describes the usage of a multi-parameter probe (hereafter, multiprobe) for the measurement of the four "Core" parameters required by the Water Resources Division for lotic sites: Temperature, Specific Conductance, pH, and Dissolved Oxygen. Additional parameters that the KLMN has included (ORP [Oxidation/Reduction Potential] and turbidity) will also be measured using the multiprobe. Measurements are made a seven equidistant points at a well mixed stream cross section.

Over the course of the monitoring project, multiprobes will wear out, be lost, become damaged, or otherwise need replacing. Although a well maintained probe could easily last a decade or longer, the Program Lead should anticipate the need to either upgrade or replace worn out components on a biennial basis. When probes are upgraded, repaired, or replaced, steps provided in SOP #19: Quality Assurance Project Plan should be undertaken to ensure data comparability. It is also the responsibility of the Project Lead to ensure that the probes and display units are in proper functioning order a minimum of 3 months prior to the initiation of field work.

The current multiprobes employed by Klamath Network are the *Manta* multiprobe with the *Amphibian* multiprobe display, both manufactured by Eureka Environmental Engineering. Although this SOP should assist in many issues that may arise with multiprobe use, occasional assistance or technical support may be necessary. Their web site and support staff should be regularly contacted for upgrades to software and firmware. Their contact information is:

Eureka Environmental Engineering
2113 Wells Branch Parkway Suite 4400
Austin, TX 78728
Tel: (512) 302-4333
Fax: (512) 251-6842
www.eurekaenvironmental.com
Sales@eurekaenvironmental.com

SOP #7: Multiprobe Calibration and Field Measurements (continued).

support@eurekaenvironmental.com

The user's guides for both the *Manta* and *Amphibian* Display are included in Appendix J. Also contained in Appendix J is a copy of the help file for the program used to manage data collected by the *Manta* and Eureka units, along with a help file for the iPAQ software version of the Eureka Pocket PC interface. The Program Lead and crew should familiarize themselves with all four of these documents prior to multiprobe use. After reading the documents, the Project Lead and crew should begin trials with the multiprobe to ensure that all are comfortable using the equipment ***prior to field work***.

The following step-by-step guide is not a surrogate for reading the manuals. However, it will fill in the gaps of usage that may not be detailed in the manuals. It also details aspects that are specific to ensuring that data are measured, collected, stored, and managed in identical manner through the life of the project.

Multiprobe Data Collection Step by Step

A. Prior to use, the *Amphibian* and *Manta* components should be checked for proper condition:
    1. The *Amphibian* is a Hewlett-Packard iPAQ model hx2490b pocket PC (hereafter, iPAQ), contained in a waterproof carry case (www.otterbox.com). The container should be inspected for the following (Figure 1).
        a. Intact and clean body O-ring.
        b. Functioning side-clasps.
        c. Intact and clean window O-ring.
        d. Secured and centered iPAQ.
        e. Clean serial port, free of dirt.
        f. Clean and covered round USB/Power Charger port.
    2. The *Manta* probe should also be inspected (Figure 2).
        a. Check for cracks in acrylic body.
        b. Inspect the integral cable connection (Figure 2). These may crack and need replacing with time.
        c. Check that the serial port is clean and free of dirt.
        d. Check that the O-rings within the acrylic body are making contact (a thin, dark line is visible).

B. Remove the red cap covering the serial port on the *Amphibian* and connect the *Manta* serial port to the *Amphibian*. **Always use the thumb screws to secure the probe to the *Amphibian***. Failure to do so may result in the probe coming off during readings.

C. Once connected, turn on the *Amphibian* by depressing the power button using the stylus attached to the unit (Figure 3).

D. The iPAQ uses Windows Mobile 5.0 operating system for functioning. Crew members should become familiar with this operating system by exploring the functions and settings prior to the field season. It is an intuitive operating system and is interfaced using the stylus to point and depress on-screen items, similar to a point and click interface on a desktop PC. Start the Eureka Software by touching the stylus to the Start menu (Program start button). This should result in a drop-down list of program options (Figure 4). Depress "**eureka**" to start the *Manta* software.

SOP #7: Multiprobe Calibration and Field Measurements (continued).

Figure 1. *Amphibian* overview – top down (Left); open (Right). *Amphibian* parts: A) Neoprene handle; B) Stylus; C) iPAQ pocket PC; D) Top serial port; E) Case clasps; F) External battery; G) Velcro straps to secure iPAQ; H) Circuit board; I) Bottom USB/battery charger port.

Figure 2. *Manta* overview. *Manta* parts: A) *Manta* body; B) Storage cup; C) 25 m cable; D) Waterproof, integral cable connection; E) Marine-grade serial port.

Figure 3. Hewlett-Packard iPAQ overview, showing relevant buttons to *Manta* multiprobe function.

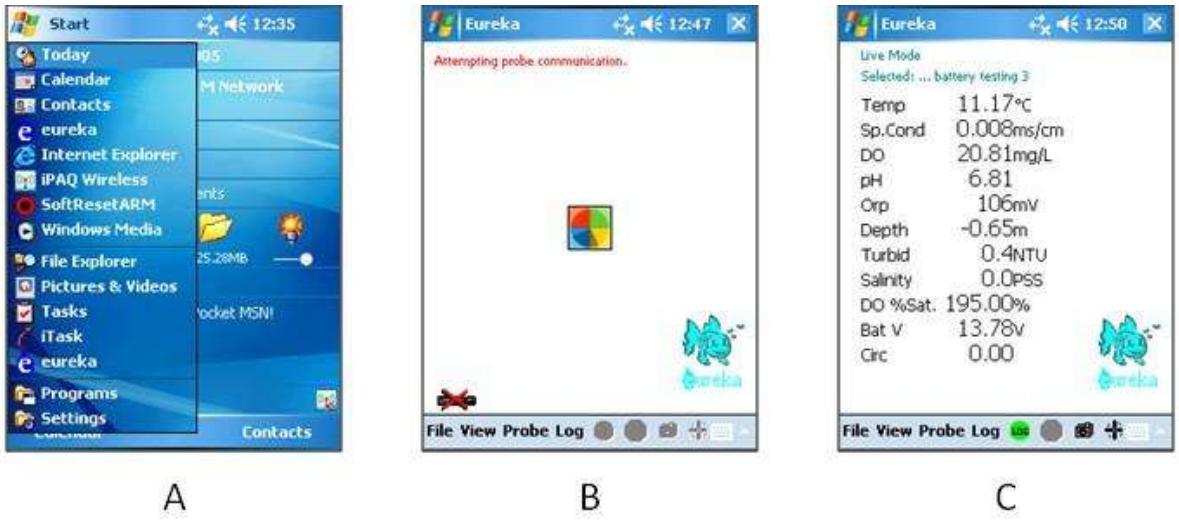

Figure 4. (A) iPAQ start up screen after depressing start; (B) Eureka start up; and (C) Eureka after probe connection.

E. Alternatively, the Eureka software can be started by depressing the "hotstart" button on the bottom left of the iPAQ (Figure 3).
F. Once started, the software will attempt to communicate with the *Manta* Probe. If a multicolor symbol appears, communication is being attempted (Figure 4b). Upon connection, data readouts will appear (Figure 4c).

SOP #7: Multiprobe Calibration and Field Measurements (continued).

G. It is now possible to proceed with the calibration steps (see below section on Calibration).
H. Before data collection, a proper file must be created in Eureka to store the data in (Figure 5a-c).
    1. Under the "**Log**" menu, depress "**Locations**." Do not use the "LOG" button (Figure 5a).
    2. Depress the "**New**" screen, so that there is an active cursor (Figure 5b).
    3. Depress the keyboard icon at the bottom of the screen to create a new "**Location**" (Figure 5c).
        a. Using the shift key so that capitals and underlines can be used in the file name structure, proceed to tap the keyboard to create the name.
        b. **The file name structure should be:** **Park_Stream_Unique_Code_Year**. Example: **RNSP_Redwood_Creek_r16_008_2009**. In this example, the stream is in Redwood National and State Parks, its name is Redwood Creek, the unique code is r16, and it was sampled in 2009.
        c. **DO NOT ABBREVIATE** due to time constraints. "**Rewood_16_10**" is not an acceptable file name. Note: Files may (and should) be created ahead of time, either by the crew or the Program Lead. Note that the list will indicate if a file has been "**used**" or is "**empty**."
        d. Once the file is created, highlight it by selecting it from the list and depress "**Select**."
I. Once the proper location file is selected, logging a data file can commence.
    1. Ensure that the proper location file is being used; it is indicated at the top of the data readout screen in small blue text. For example, in Figure 5a, the active location file is "**battery testing 3**." If this is not the proper file, return to the log screen and select the proper file.

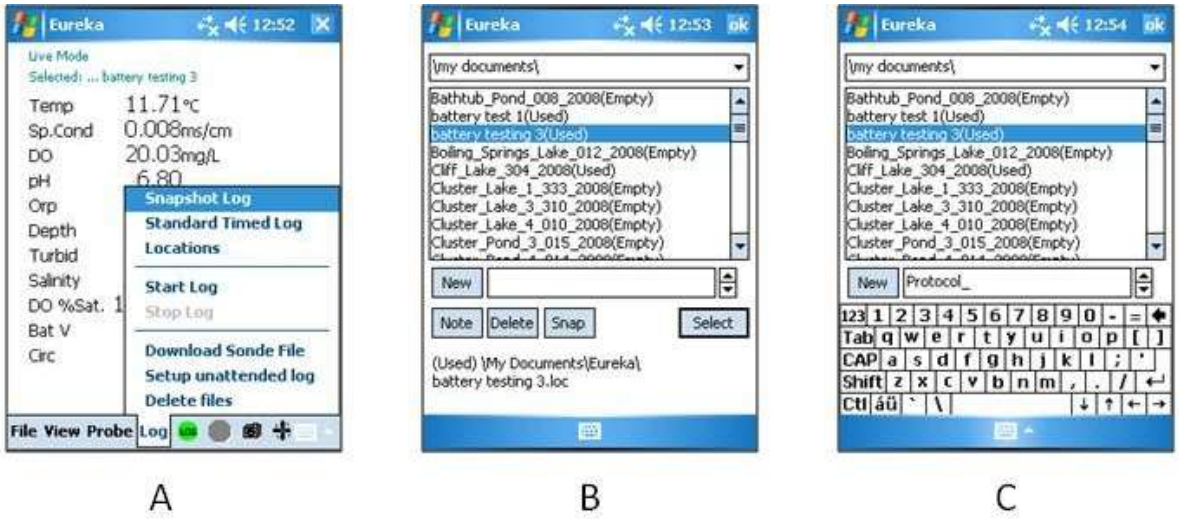

Figure 5. (A) Eureka screen captures for creating "**Location**" files, under "**Log**" command; (B) Selecting an existing "**Location**" file or creating new "**Location**" files; (C) Using keyboard function to name "**Location**" file.

SOP #7: Multiprobe Calibration and Field Measurements (continued).

J. At this point, allow the probe to stabilize readings. When ready to record data, depress the snapshot log icon, " ." This will record a single point measurement. Move the probe as appropriate and depress the " " to take an additional reading. You will receive the option of "**Append**" or "**Overwrite**" (Figure 6c). Choose "**Append**" to add to the data file.
K. Repeat step J until all necessary measurements have been made.
L. When you are done collecting data for the stream, select the "**File**" followed by "**Exit**" to shut down the software. Congratulations! Note, if you do not select "**Exit**," the *Amphibian* will continue to draw power even while shut down.

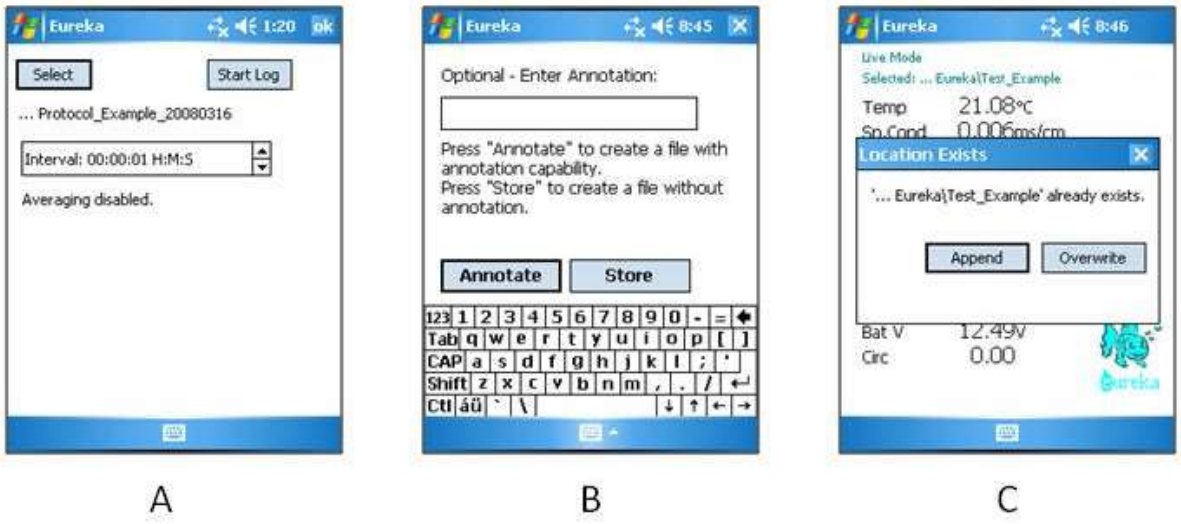

Figure 6. Eureka screen captures for initiation of data logging: (A) Setting the logging interval (DOES NOT APPLY FOR STREAMS); (B) Annotation option; and (C) Appending or overwriting an existing file.

Stream Cross Section Step by Step

Along with the basic instructions on how to collect data, the following steps should be followed in collecting the stream cross section.

A. While on shore, check the calibration of dissolved oxygen (% saturation), pH, and conductance, and if necessary, recalibrate, following the steps outlined in "Calibration Step by Step."
B. Connect the *Amphibian* to the *Manta* while on shore; replace the storage cup with the weight (Figure 7).

SOP #7: Multiprobe Calibration and Field Measurements (continued).

Figure 7. After removal of storage cup, weighted cup on left is attached by screwing into the *Manta* body. Note that the weight is heavy and exerts leverage. Use a firm grasp so that the weighted cup does not interfere or break any of the probes.

C. Select a cross section of the stream that fits the following criteria:
    a. Has moderate to fast velocities.
    b. Appears well mixed.
    c. Has minimal turbulence.
D. Visually break the stream into seven equidistant points and place the probe in the water at the nearest of these points. The best way to discern this is to use the width at the cross section, divided by eight. This is the distance from the near shore that the first reading should be taken. For example, if the width is 2.5 meters, the first point measurement should be at 0.31 meters from the shore.
E. Collect a single point measurement when the probe has stabilized, following the above instructions.
F. After recording data, move the probe over to the next point. Using the example above (2.5 m width), the probe would be moved another 0.31 meters from the shore (a total of 0.62 meters from the near shore).
G. Repeat until all seven measurements have been collected in a single file.
    a. When making the seven measurements, look for low variation in the conductivity readings. If they are highly variable, the cross section is not in a well mixed area and should be moved until a well mixed area is found. The middle of the stream of the well mixed area will serve as the collection point for the water chemistry sample (SOP #8: Water Chemistry Sample Collection and Processing).
    b. When entering the water, position your body downstream of the probe. Disturbance upstream will bias the readings.
H. Bring the probe back to the stream side and shut it down.
I. When shutting it down, be sure to exit and close the program. Turning the unit off without shutting down will cause the program to continue to draw power from the batteries.
J. Remove the weighted cup and replace it with the storage cup. The storage cup should be approximately 1/3 full. It is not necessary to fill it completely.
K. Download the data file to the computer and archive it according to instructions in SOP #17: Post-site Tasks.

SOP #7: Multiprobe Calibration and Field Measurements (continued).

Calibration Step by Step

Regular calibration is an important component of maintaining quality control on data collected with instrumentation. The calibration, calibration check, and acceptable range schedule for each parameter should be followed as in Table 1.

Table 1. Calibration guidelines for *Manta* multiprobe. The probe should be calibrated at the beginning of the work week. When calibration checks are outside the acceptable range (compared to reference solutions), the probe should be recalibrated in the field. (NIST - National Institute of Standards and Technology)

Parameter	Calibration Interval	Calibration Check	Acceptable Range	Notes
Conductance	1/week	per sampling site	± 5 µS/cm	
Dissolved Oxygen (% Saturation)	1/week	per sampling site	± 5%	Calibration is best done the day before deployment, in case the membrane must be replaced. Membrane replacement does not negate calibration, only that recalibration will be necessary within 24 hours.
pH	1/week	per sampling site	± 0.3	
Redox (ORP)	1/week	NA	± 40 mV	
Temperature	NA	1/month	± 0.3 °C	Temperature is factory calibrated, however checks against a NIST thermometer should be done 1/month.
Turbidity	1/week	NA	± 3%	

In general, the probe should be calibrated the day or evening before a work week commences. The probe should be calibrated in the five main parameters, regardless of whether or not it is in the "acceptable range." When in the field, prior to measurement, a quick check against a known solution or another reliable probe should be done. If the parameter measurement is outside the acceptable range, the technician should recalibrate prior to making measurements using a calibration solution. **Record results of calibrations and calibration checks on the appropriate logsheet (Appendix F).** Additionally, although the calibration may require a multipoint calibration, the calibration check can be against a single value, as close as possible to the anticipated measurement value.

Generic Calibration Step by Step

A. Attach *Manta* to *Amphibian* as above for multiprobe data collection step by step.
B. Once operating and the probe is reading (as in Figure 4c), remove the storage cup and replace with the calibration cup (Figure 8).

SOP #7: Multiprobe Calibration and Field Measurements (continued).

Figure 8. Calibration cup with black covering used for calibration procedure.

C. At this point, the probe must be maintained "upside-down" or in an inverted state until calibration is complete.
D. Tap on the "**Probe**" menu option, followed by "**Calibration…**" **(**Figure 9a). From the drop down list, select the parameter to be calibrated (Figure 9b).
E. Once selected, tap the appropriate number of calibration points:

Parameter	# of calibration points	Calibration points
Dissolved oxygen (%saturation)	1	@100.00% for 60 seconds
pH	3	@7.00, 4.00, 10.00 for 60 seconds
Redox (ORP)	1	@0.00mV for 1 second
Specific conductivity	1	@58.64ms/cm for 60 seconds
Turbidity	2	@0.00 and 100.00 NTU for 60 seconds

F. Choose the appropriate options (e.g., for pH: "**@7.00 for 60 seconds**").
G. Prior to initiating (by tapping "**Calibrate**"), rinse the probes with a wash bottle of deionized water, shake dry, and fill with the appropriate calibration solutions, so that the probe is covered.
   a. If doing dissolved oxygen, do not fill the cup. Rather, fill until just below the dissolved oxygen probe. Place the black rubber cap on top of calibration cup and let the probe equilibrate for 3 or 4 minutes. This creates a 100% saturated air pocket within the calibration cup.
H. When the appropriate solution is in the cup, and the probe has equilibrated, tap "**Calibrate.**" (Figure 9a). Follow instructions on the *Amphibian* (Figure 9b).
I. When doing dissolved oxygen, be sure to maintain the probe vertical, so that no water gets on the oxygen membrane.
J. Once all calibrations are done, click "**ok**" in the upper right corner. Click "**Yes**" to save the calibrations (Figure 9c).
K. Record results and date and time of calibration on calibration tracking form (Appendix F).
L. Remove calibration cup and replace with storage cup or with weighted cap for data collection.

Dissolved Oxygen Membrane

When calibrating dissolved oxygen, the calibration may occasionally fail, or while using the probe, the operator may notice that an inordinate amount of time may be required for the probe

to equilibrate. Both of these are signs that the membrane may be wrinkled, have an air bubble, be damaged, or has otherwise "gone bad." Such a membrane will need to be replaced, along with electrolyte solution. For this reason, the field crew should always carry spare membranes and electrolyte solution with them to the field site.

Figure 9. Eureka screen captures for calibrating probe: (A) Selecting parameter; (B) Waiting for calibration stabilization time; and (C) Saving calibration set points.

Excellent instruction on how to replace the membrane is provided in Appendix J, Eureka Environmental *Manta* manual. A digital copy of this manual will be available on the tablet PC computer the crews have in the field. Crew members should be trained in membrane replacement. Recalibration will have to be performed after replacement, ideally after a 24 hour period to allow the membrane to relax and stretch. Calibrations after the 24 hour period will be more stable and last longer. If the membrane replacement is done on-site, the calibration is still valid. However, the calibration will not "last," so that if measurements are retaken later in the day (3^+ hours, for example), the probe will need to be recalibrated. In other words, the calibration will not "hold" unless it is calibrated 24 hours later. However, accurate readings can still be taken immediately after membrane replacement.